

## **CAN END CONVERSION SYSTEM**

### **Related Application**

[0001] This application is based upon Provisional Application Serial No. 60/420,397 filed 22 October 2002 and incorporates the entire disclosure of that application herein by reference.

### **Field of the Invention**

[0002] This invention relates to systems for making unique container ends, particularly at full production rates, by moving container shells through progressive conversion tooling wherein the shells are scored, embossed if desired, formed with a pour opening, and then securing a foil-like tab sealed to the shell in position covering the pour opening.

### **Background of the Invention**

[0003] This invention provides a continuous process and apparatus which converts the can end shells, applies foil-like tabs to the shells, and discharges the completed ends at commercially viable speed. Containers, principally metal cans, have been widely used for packaging liquid beverages, e.g. beer, carbonated drinks, juices, and the like, which are intended for human consumption. Many such containers comprise a can formed of a one-piece body and a fabricated integral easy-open end which is attached across the open end of a filled can body, as by a roll seal. Such ends have an integral pour opening defined by a score line which separates during opening of an attached tab. There are many existing forms of filling and sealing devices for filling and closing such cans with artificially or naturally carbonated beverages (e.g. the bear/beverage market), as well as other drinks or flowable foods and the like.

[0004] There is also an objection, more prevalent in some countries, to the “attached pour panel” which in turn was the result of the ecological objections to its predecessor the “pull tab” (removable) end. The panel/tab items often were not properly disposed of. The integral pour

opening panel which remains connected to the container end, is conventionally pushed into the container, often partly into contents (usually liquid) of the container.

[0005] There also exist a number of food packaging systems which place a measured quantity of a food or drink in an open top container body onto which a foil-like cover is sealed to the top of the container body; see for example U. S. Patent No. 5,758,475 issued 2 July 1998, and the prior art cited therein. Such covers can be formed economically by a simple stamping operation on a foil supplied from a roll thereof.

[0006] It has been suggested to apply a foil-type cover (or foil-like tab) onto a formed pour opening in a can end shell, instead of forming an initially integral pour opening and attaching an operating tab with the well known integral rivet structure for severing and opening the pour panel. In such a container end the shell (in known sizes and shapes) can have a pour opening formed therein, preferably with a protective rim. The shell is also formed with a suitable peripheral flange for sealing to the open top of a can body. Then the end is completed by applying a sealing tab across the pour opening. The foil-type tab can be easily and properly thrown away.

[0007] Such an end is disclosed in U.S. Patent No. 3,312,368, (see Figs. 1A, 1B and 1C, Prior Art) which discusses the potential advantages of such a container end, and also discloses an optional venting arrangement to relieve internal pressure from the container before the foil-like tab is removed from the pour opening.

[0008] In addition, U.S. Patents 4,397,401 and 4,526,287 disclose foil tabs for container ends (see Figs. 2A and 2B, Prior Art) wherein the rim of the pour opening is formed (e.g. tapered or projected) toward the outer or public side of the end. If the attached tab is deformed outward, the stress applied between the tab and the tapered lip of the pour opening is not a peeling force but a shear stress, and peeling away of the tab from the pour opening due to such internal pressure is effectively prevented.

[0009] To the best of applicants' knowledge, at present the equipment available for continuous manufacture of such ends is relatively slow and produces the ends at low speed (e.g. three ends / cycle), and is simply not able to operate at speeds and in quantities desired for high volume production. Applicants have determined that such equipment should include the ability

to accept end shells (which are usually made separately), form the pour opening in each shell, form and attach the foil-type tab over the pour opening, and seal the tab to the external (public) side of the resulting end, in one continuous operation.

[0010] An important need of such equipment is the ability to hold the shells firmly as  
5 they are formed and sealed. Precise alignment of the tabs is important. In particular, there is an important need to prevent rotation of the shell during the forming and sealing processes so as not to interfere with alignment of the tabs over the pour opening. Another need is to provide a sealing apparatus and method which places the foil securely over the pour opening, applies the seal, reforms the perimeter of the pour opening with the tab in place, and allows the seal between  
10 the tab and the pour opening then to set before ends are ready to be discharged and gathered. A further need is to achieve the most efficient use of the foil material to minimize the amount of scrap.

[0011] A conveying apparatus, including unique nests, which are features of a novel converting system for making easy-open can ends, is disclosed in U.S. Patent No. 6,405,853  
15 issued 18 June 2002 and its corresponding published Intl. Application No. PCT/US99/27978 filed 26 November 1999 (both assigned to the assignee of this application). The present invention includes the incorporation of this conveying apparatus into a unique system for the manufacture of the above described foil-tab sealed ends.

### **Summary of the Invention**

[0012] The preferred transfer conveyor system of the present invention utilizes a conveyor comprising at least one continuous belt (in some cases a plurality of such belts operating in parallel) of reinforced flexible material, with cogs or teeth on the belt underside. A series of unique and novel nests (see U.S. Patent 6,405,853) are fitted into holes in the belt at regularly spaced intervals along the belt(s). The nests are attached at their opposite edges to the belt(s), which are positively driven and advance end shells in the nests intermittently through the end forming tooling and then through the foil-like tab forming/attaching and finishing equipment of the system.

[0013] The belt(s) are supported by and routed around first and second drums located beyond the beginning and end of the combined end shell tooling (for pour opening formation) and the foil-like tab forming/attaching and finishing stations. In proximity to the ends of this conveying system are loading (down stacker) mechanisms and unloading (e.g., up stacker) devices. One or both of the drums are driven to move the belt(s) step-wise along an upper flight, such as to advance the nests in predetermined increments, and a lower or return flight.

[0014] The progressive end conversion tooling for shaping the shells into container ends, with formed and finished pour openings, is located in the mouth or entrance of the press, and the belt(s) passes the nests and shells therein between the upper and lower conversion tooling sets.

[0015] The tab forming and application tooling is preferably located beyond the conversion tooling but principally within the boundaries of the mouth of the same press. A supply web of foil material is fed step-wise across the conveyor(s) at the forming and application station. A blanking apparatus at each of the application locations acts to create and to separate (e.g. die cut) tabs from the foil and tack the tabs against the shells, covering the pour openings. The tabs are then heat sealed over the pour opening. The tab area around the pour opening rolled perimeter, with the foil-tab attached, may then be re-formed to provide a surface sloping slightly downward and away from the pour opening to enhance adhesion of the tabs to the shells in that region, using unique tooling disclosed hereafter.

[0016] Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

### **Brief Description of the Drawings**

[0017] Figs. 1A, 1B and 1C are views from the prior art of a foil-type tab applied to a container end shell.

[0018] Figs. 2A and 2B are views from the prior art illustrating details of a bonded interface between a foil-type tab and a shell surface about the pour opening.

5 [0019] Figs. 3A and 3B are views of another design of foil tab and of a related end shell with the tab applied and the covered pour opening indicated in dotted lines.

[0020] Fig. 4 is a plan view of the system including portions of the conveyor drive, with the end tooling, the foil supply, and the tab application equipment shown schematically.

[0021] Fig. 5 is an abbreviated side view of the press and conveyor system, with some parts shown schematically.

5 [0022] Fig. 6 is an abbreviated view of the rear of the press.

[0023] Fig. 7 is an enlarged plan view of a segment of the top flight of one three lane belt, including attached nests for carrying end shells as they are converted into ends.

[0024] Fig. 8 is a partial plan view of a lifter pad for the transfer belts, located in the region where the belts traverse the various tooling stations.

10 [0025] Figs. 9, 10 and 11 are top and cross-sectional views of a nest as disclosed in U.S. Pat, 6,405,853, with an end shell located in the nest in Fig. 11.

[0026] Fig. 12 is an enlarged plan view of a segment of the top flight of one three-lane belt (which would moved upwardly in the view), showing the stations of three lanes of end conversion tooling, and the entry to the following tab operations stations.

15 [0027] Fig. 13 is an enlarged plan view of a further segment (continuing upward from Fig. 12) of the same three lane belt and a progression of corresponding tab forming and application stations.

[0028] Figs. 14A--E are cross-section views taken through the progression of the formed end shells at the stations shown in Fig. 12.

20 [0029] Fig. 15 is an enlarged top plan view showing segments of four three lane belts, the foil feeding and embossing, tab cutting and forming and tab application stations, and foil skeleton removal.

[0030] Fig. 16 is a substantially enlarged segmental view of the layout of tabs on the foil.

[0031] Figs. 17A, 17B, 17C are three partial cross-section views through three stations of  
25 the tab forming and tacking stations showing their progression.

[0032] Fig. 18 is a schematic plan view taken across the foil feeding and tab forming and applying stations.

[0033] Fig. 19 is an enlarged partial end view of one of the plates shown in Fig. 18, with the foil engaging bar raised.

[0034] Fig. 20 is an enlarged partial end view, similar to Fig. 19, showing the foil engaging bar contacting one edge of the foil.

[0035] Fig. 21 is a partial side view of the plate and foil engaging bar.

[0036] Fig. 22 is an enlarged cross-section view of one set of the tools at a tab forming and tacking station.

[0037] Fig. 23 is a perspective frontal view of one set of the upper tab heat sealing and reforming tools.

[0038] Fig. 24 is a plan view of the face of one of the lower tab heat sealing and flanging lower tools.

[0039] Figs. 25 and 26 are, respectively, enlarged open and closed cross-section views of the tooling at one of the heat sealing and reforming stations.

### **Description of the Preferred Embodiment**

#### **Ends with Preformed Pour Openings and Foil-Type Tabs**

[0040] Referring to Figs 1A, and 1B (Prior Art), it has been known for many years to apply a foil-type cover (or tab) 13 onto a pour opening 12 formed in a can end shell 11 which may be of aluminum, lightweight tin plate, or conventional tin plate. Such an end and removable tab (termed a peel tab) is disclosed in U.S. Patent No. 3,312,368, as mentioned above. The pour opening 12 preferably has a rim including a protective coating. The tab 13 includes a sealing portion across the pour opening and a free end 16 to grasp in removing the tab. A preferable tab is light gauge (~0.009 inch) aluminum. Shell 11 may also be formed with a suitable peripheral flange for sealing to the open top of a can body.

[0041] The container end described therein is intended for use with liquid contents under pressure, and may also have an optional venting arrangement (Fig. 1C) comprising a separate opening 12V in the end covered by part of a tab and opened as the tab is removed to relieve internal pressure from the container.

[0042] U.S. Patent 3,547,305 discloses forming an upward curl about the rim of a pour opening. U.S. Patent 4,526,287 discloses foil tabs for container ends (see Figs. 2A and 2B, Prior Art) in one form of which the rim 17 of the pour opening is formed (e.g. tapered or projected)

toward the outer or public side of the end, preferably at an angle of 151 to 301. As stated in that patent, if the attached tab is slightly deformed outward the stress applied between the tab and the tapered lip of the pour opening is not a peeling force but a shear stress, with the result that accidental peeling away of the bonded portion of the tab, especially around the pour opening, is effectively inhibited.

[0043] This prior art also points out that the shape of the pour opening can be freely changed; for example, circular, ellipsoidal, egg-like, rain drop-like, oval, or gourd-like openings can be used, and they can be formed in various sizes of end shells. The system of the present invention can readily accommodate such size and/or shape changes. For purposes of the present description, a shell 20 with a somewhat rounded triangular pour opening 22, provided with a rolled rim 23, and fitted with a foil tab 25, is shown in Fig. 3B. The tab itself is shown in Fig. 3A. The tab includes a central area 26 covering pour opening 22, a frontal or forward area 27, and a handle or operating extension 28 having a ruffled embossed area to provide an enhanced grip. The area 29 surrounding the pour opening and nearby portions of tab 25 is preferably tapered upward similar to the showing in Fig. 2B.

#### **System Layout**

[0044] Figs. 4, 5 and 6 show the overall configuration of an end building system in accordance with the invention, including a reciprocating press apparatus. Such a press may have a capacity in the order of 350 Tons (U.S.), operating at 150 to 170 strokes/min. A typical such press is a Minster Model E2 HF-350 available from Minster Machine Company, Inc. of Minster, Ohio, U.S.A.

[0045] The press includes a bed B, a crown C supported upon side frames which include multiple posts P extending upward from bed B, and a vertically reciprocating ram R which is guided in its vertical motion by posts P. The crown C houses a motor driven crankshaft CR fitted with crank-rods or links (not shown) attached to ram R. The space between ram R and bed B defines the mouth of the press, usually of rectangular shape, and multi-station progressive tooling is mounted to the underside of ram R and the top of bed B to cooperate in performing successive operations upon can end shells as the shells are advanced in increments from one station to the next, from front to back (in the illustrated embodiment) through the press.

[0046] Upper and lower tooling sets for working on the shells to define and form a pour opening, and defining and applying foil-type tabs, indicated by the general reference numerals 30 and 31, are mounted to ram R and on bed B, respectively. The tooling sets 30 and 31 are divided approximately equally between the front half and rear half of the press mouth. The upper  
5 tools are fitted to a punch plate 35A which in turn is supported on ram R, and lower tools are fitted to a bed plate 35B on the press bolster or base B.

[0047] Crankshaft C is fitted with a power take-off pulley 38. Fig. 6 shows a belt 40 which transfers power from crank pulley 38 which is connected to a drive shaft 45. Shaft 45 (see Fig. 6) may be connected through a right angle drive 48 to an intermittent drive unit 50, of  
10 conventional construction, which drives the conveyor, and to servomotor drives SM-1 and SM-2 for foil feeding equipment.

#### **Conveyor**

[0048] The system provided by this invention uses a nest-type conveyor system as disclosed in said U.S. Pat. 6,405,853. It includes the intermittent drive unit 50 connected to a shaft 53 supported at the rear of the press (Fig. 6) in outboard bearings 54 and carrying first  
15 drum(s) 55A--55D which are rotated together in timed intermittent fashion, synchronized with the rotation of the crank C and motion of press ram R. The conveyor belt(s) 60 move forward through the press mouth when the press is open (e.g. the ram is up) in increments which match the spacing of the stations within the tool sets.

[0049] At the front of the press, outboard of the press frame and posts P, second drum(s)  
20 57A--57D (Figs. 4, 5 and 6) are supported in suitable bearings 58. Drum(s) 57A--57D may optionally also be driven by drive unit 50. Extending between each set of drums 55A--D and 57A--D are endless conveyer belts 60A--60D (in a preferred embodiment there are multiple such belts operating in parallel) fitted with integral drive teeth 61 on their undersides(see Fig. 7). The illustrated embodiment employs four such belts 60A, 60B, 60C and 60D, each with three lanes,  
25 to provide a total of twelve lanes I-XII for a 12-out system (Fig. 4). One or more tensioning devices 83 urge drum 57 in a direction away from drum 55, maintaining tension in the belt, particularly along upper flight 60UF. It should be understood that various numbers of belts, each



with one or more lanes of nests, are within the purview of this invention. The system disclosed herein uses four such belts, as explained hereinafter.

[0050] The belts 60A-60D extend front to back of the press and each belt is of the 'endless' type, with the toothed underside passing about the two drum sets 55A-55D and 57A-57D and their drive teeth, forming an upper or active flight 60UF and a lower return flight 60LF. Each belt also is provided with multiple rows or lanes (e.g. three lanes I, II and III in belt 60A, etc.) of openings 62 (Fig. 7) which are regularly spaced to correspond to the spacing of the centers of the tooling stations. In these openings are nests 65 of a diameter such that ears 66 on the nests overlap the edge of the openings 62 (Figs. 7 and 15).

[0051] The nests 65 are relatively light weight and preferably are rigid molded plastic parts, which are placed in openings 62 along the lanes in each belt and attached to the belt by pins 67 through ears 66 (Figs. 6, 7 and 10), aligned transversely of the path of travel (e.g. length) of the belts. Thus shells deposited in the nests are carried through the tooling 30 and 32, in intermittent or step-wise fashion, synchronized to the operating strokes of the press.

[0052] Shells S to be converted are loaded onto belt 60 at the loading station indicated by general reference numeral 68 in Figs. 5 and 6. Completed shells which have a pour opening of chosen configuration, and have a tab sealed over such pour opening, are unloaded from the nests at or beyond the rear of the press.

[0053] The shell loading mechanisms are also referred to in the art as a down-stacker mechanism, in reference to the manner in which it takes single shells from the bottom of a supply stack and places a single shell S into each nest 65 at the loading station 68. The shell loading mechanisms 66 are located on the press (Fig. 5) outboard of posts 12 and 14. These mechanisms are per se known; see U.S. Patent No. 6,405,853.

[0054] There are multiple down-stacker mechanisms, each designated by the general reference numeral 65, one each of which (Figs. 4 and 5) is mounted over the conveyor lanes I-XII. Base plate 67 holds these mechanisms, and is mounted over conveyor belts 60A-D, outside of the press frame. A bottom plate 68, to which the base plate is bolted, includes vacuum chamber 78 (Fig. 1) to which a vacuum hose fitting is attached from a suitable source of vacuum

VB. Plates 67 and 68 are recessed to define shallow passageways 70 receiving the conveyor belts 60A-D.

[0055] Above chamber 78 there are circular feed openings of a diameter just large enough to pass the shells S which descend from a stack thereof contained within guide rods. The lowermost shell S has its lip supported on the feeding threads of three feed screws spaced around each feed opening such that one full rotation of these screws will carry the lowermost shell from the stack and deposit the shell in a nest 65 located beneath the feed opening. The power and timing for the feed screw rotation is derived from a belt which is driven from power take-off shaft section 45 as earlier described. By proper selection of pulley sizes and gear sizes, teeth numbers, and ratios, the intermittent rotation of the shaft is translated into 360° rotations of feed screws, and a single shell is deposited in a nest 65 as those openings halt under the feed opening.

[0056] In the system as illustrated, twelve series of ring shaped nests 65 (preferably circular) are arrayed in lanes I-XII, along the four flexible conveyor belts 60A-D, e.g. three lanes per belt. Nests 65 have an underside (Figs. 10 and 11) resting on the belts 60A-D at the edge of openings 62 to define the vertical or height dimension of the nests in the belt. The nests have a rim 74 which is fitted into the corresponding opening 62. Independently flexible gripping fingers 75, which are integral to rim 74 through flexible arms 73, present a discontinuous ledge 76 through which the curl C of an end shell S initially passes (Fig. 11).

[0057] A shell is placed into a nest ring by moving the shell with curl C upward and its central panel P and chuck wall CW facing downward (see Fig. 14). The curl is pulled through the inward and downward tapered fingers 75 and onto the lower rim. The bottom of the shell, including the lower end of its chuck wall CW and the central panel P, is then located at the lower edge of the nest with curl C between the lower rim surface 71 and fingers 75 as explained in U.S. Patent No. 6,405,853.

[0058] Fingers 75 are somewhat opened in a radially outward direction during this process, and then close inward entirely around and over the shell curl C, so as to exert a centering force on the shell as it is loaded into the nest, and to hold it securely about its entire periphery. This retains the shell especially against turning as the shell progresses through the tooling stations while various operations are performed on it and a tab is attached to it.

[0059] The shells are snapped in place and firmly held by insertion assemblies 85 of like construction, each including an insertion head 85H which has its lower face shaped to conform generally to the inner upper surface of a shell placed in a nest. These insertion heads are arranged to push a shell positively into engagement with the internal teeth of each nest, one station (drive step) before the shell passes into the tooling; see U.S. Patent No. 6,405,853.

[0060] The attachments between nests 65 and belt 60 allow for limited controlled relative movement of the nests, but only in directions tangent to the turns of the belt about the drums, thus the nests remain flat about the turns and can carry parts (the shells and resultant ends) about drum 55 from the upper to the lower belt flights.

[0061] The upper flight 60UL of the belts is lifted upward by spring biased lifter pads 84 (Fig. 8) when the press is opened, and the belts and attached nests 20 are moved incrementally forward over the lifter pads, to locate nests 65 successively in alignment with the progressive tooling stations. This is disclosed in said U.S. Patent No. 6,405,853.

[0062] Figs. 6 and 12 illustrate general details of the upper and lower tooling sets 30, 31. The punch holder plate 35A is fastened to the bottom surface of the ram R, and a base plate 35B is supported below, in the space between the flights of belt 60.

[0063] Thus, shells placed in the conveyor nests are carried progressively to the succeeding stations of the shell conversion tooling by each step-wise movement of the conveyor. When the press opens (ram rises) conveyor 60 is indexed (left to right in Fig 5 ). Preceding conveyor motion, the stripper pad(s) 84 (Fig. 8) is raised to guide the conveyor above the die tools. The conveyor belt(s) 60A-60D are taut in the upper flights 60UF and level across the lifter pads. In this position the belts advance only after the lift movement has stopped. The shell converting path thus defined extends from side to side of the press and the conversion tool stations (along with the tab forming and sealing stations described below) are laid out on the die shoe and punch holder plate in such fashion that they are generally symmetrically disposed with respect to the front to back center lines of the press so as to distribute loads over the press mouth. As further described below, foil tab forming and attaching stations IT-XIIT are arrayed along belts 60 beyond the location of the shell conversion tools (Fig. 4).

[0064] Details of the face tools in the individual punches and dies are not shown since these are not necessary for an understanding of the present invention and will vary with the design of a particular pour opening and tab. The sequence of the shell conversion operations are illustrated in Fig. 12 and the cross-sections of the progressively formed shells are shown in Figs.

5 14A--14E. Basically, a shell is formed with a pour opening of predetermined shape, and the edge or perimeter of such opening is provided with a rolled configuration to avoid a sharp edge around the pour opening, for example in case a user desired to drink directly from the pour opening

[0065] Thus, as particularly shown in Figs. 12 and 13, the stations of the shell conversion tooling, along with the conveyor, define side-by-side shell conversion paths, the final ones of  
10 which are approximately midway of the lengths of the paths. At that location a relatively wide foil strip FS is guided and advanced, step-by-step in a side-to-side direction across the belts. In this area the tabs are formed (cut) from the foil strip FS and tacked to the shells, extending over the pour openings. The skeleton remains of the foil are moved away past the far side of the last belt 60D, and may be chopped into fragments suitable for scrap disposal such as shown at the  
15 right end of Fig. 15 (labeled Foil Scrap Chopper).

#### **Tab Tooling and Tab Attachment**

[0066] As previously mentioned the tabs are formed from a strip of aluminum foil or like material. In the embodiment shown in the drawings the relatively wide (e.g. about 13 inches wide) foil strip FS is supplied from a roll RFS mounted on one side of the press mouth and directed along a tab forming and application path 70 which is transverse to the path of belts 60.

20 This foil strip encompasses the twelve tab paths for supplying tabs to each shell in the lanes I-XII. The downward facing side of the foil has a heat sensitive adhesive (normally dry) applied to it. The edges of strip FS slide along, and are supported on, spaced apart rails 72. Strip FS is moved along path 70 in steps as the strip traverses across the paths of belts 60, through the first set of tab forming and application tooling stations (see Figs. 13 and 18). The step increment is  
25 determined by the length of the chosen tab (which in this case is the tab illustrated in Fig. 3A), the tab orientation as it is formed from the foil strip FS, and the spacing between successive ones of the tab forming and application stations across the belts 60. The tab forming and applying

stations IT-XIIT are arrayed in an echelon fashion (Figs. 4, 13 and 15) at the intersections of the lanes and the tab paths as later described.

[0067] The tab design is chosen to maximize usage of the foil. As part of the specific design disclosed, the tooling in related stations across the conveyor belts is reversed by 180° such that the formation of the pour opening is on opposite sides of the centerline of the end shell lengthwise of the belts. This layout is apparent in Figs. 12, 13 and 15. In the three rows of belt 60A, the tabs 25 have their forward areas 27 to the left in the lanes I and III, and to the right in lane II. This alternate relationship of the tooling is carried through the several belts in a system. The outline of removed tab material shown in Figs. 13 and 16 demonstrates this layout of the tabs along the twelve paths lengthwise of foil strip FS. Nesting of the tab shapes, facing first to the left, then to the right, is apparent from this drawing. The remains or skeleton of the foil strip can be seen in Figs. 15 and 16, which shows an enlarged segment of the strip just past lane XII. The shadowed areas of the tabs 25 represent removed foil openings, leaving relatively thin connections between openings.

[0068] Fig. 13 and 15 show the feed increment of the foil strip FS, with small cross-hair (+) marks in Fig. 15 identifying the center point of each tab 25 aligned over the pour openings of the shells. Thus, in Fig. 15, the first tab formed from strip FS is over the lane I tab forming and applying tools. The outlines of tabs across the lowermost tab paths illustrate the progress of the skeletal remains of the foil. The increment of foil feeding is equal to about 1 2 times the lengths of tabs 25 as measured along the foil strip. The tab forming and applying tooling sets (see Fig. 22 for details) are identified broadly as I-T through XII-T and are arranged in a step-like (echelon) fashion across the lanes I-XII as shown in Figs 4 and 15). The center-lines of this tooling are located in the respective lanes at their intersections with the twelve paths along the foil strip from which the tabs are formed.

[0069] The step-by-step movement of strip FS is precisely controlled by a set of four movable frames 75A, 75B, 75C and 75D (Fig. 18) which are each the approximate width of a belt, and which confine the strip edges close to guide rails 72. These rails may be L-shaped in cross-section, having a horizontal leg 73 and a vertical leg 74. Frames 75A-D have side rollers 78 (Figs, 19 and 20) which support the frames for limited movement along the vertical rail legs

74. The frames each have presser bars 77 fitted into their opposite sides (along the foil path) and are moved between retracted or raised positions (flush with the plates' lower surfaces) and extended positions in which the presser bars contact narrow areas along the edges of foil strip FS.

This up-down motion of the presser bars is controlled by small pneumatic piston devices 79

5 mounted in the frames. When bars 77 are raised, the corresponding frames will pass freely over the foil edges; when the bars are extended they will press a length of the foil strip edge (equal to the bar's length) against the guide rails and push the strip forward by the predetermined increment.

[0070] The frames 75A-75D each have apertures 80 formed therein which provide access

10 for the tab forming and applying tooling from above and below the frames. These apertures are sized and shaped to surround the various sets of tool at each of the stations T-I ....T-XII whether the plates are in their respective advanced or retracted (alternate) foil indexing positions, so the tooling sets can function at each stroke of the press ram. Thus, while the frames accomplish the foil feeding incremental motion, moving alternately as described above, they maintain clearance

15 at all times for the tab forming and applying tooling and related mechanisms.

[0071] Referring to Fig. 18, the frames 75A and 75 C are connected for joint motion by one or more struts 82, and frames 75B and 75D are similarly connected by one or more struts 83.

These two sets of frames are independently movable, such that either set can advance strip FS independently of the other set, so long as the presser bars of the other set are raised. The reason

20 for this alternate dual motion relates to the relatively large mass of the plates, and the short time available for this movement during a press cycle.

[0072] Thus, each connected set of frames 75A and 75C , and 75B and 75D, will alternate in engaging edge portions of strip FS and are cycled such that the strip FS is moved along path 70 first by one set (with presser bars engaged) for one feed increment, while the other

25 set of frames has its presser bars raised (released). The intermittent timed drives for this movement are provided by the servomotors SM-1 and SM-2. It follows that at all times some of the presser bars are extended against the foil strip edges and keep the strip taut during and between the intermittent strip feeding action. During this intermittent incremental feeding action strip FS is guided by the upward extending legs 73 on the edges of rails 72 to keep foil strip

aligned as it is moved step-wise along its path 70, all the way through the various tab application stations I-T, II-T..... IIX-T (etc.), toward the opposite side of the press. Details and function of these stations are explained hereinafter. Once the depleted (all tabs removed and placed) strip FS moves beyond that last application station, the scrap skeleton remains of the strip (Figs. 15 and 16) may be cut into suitable pieces in a scrap chopper 80 actuated during each press stroke, and the pieces are discharged.

[0073] Referring to Figs. 15 and 17, at each of the tab forming and applying stations there is a set of upper and lower tooling as shown in Figs. 17A, 17B and 17C and in Fig. 22. The lower tooling comprises essentially an anvil 80 which engages the underside of a shell, with its pour opening aligned as previously explained, within a nest, and supports the shell as a tab is applied onto its upper surface, covering the pour opening.

[0074] The upper tooling comprises an outer die cutting member 82, with an internal cut edge 83 shaped to the desired external configuration of a tab 25, and a reciprocating cutter 84 with an external cut edge 85. Within cutter 84 is a placer probe 87 which is extendable from the cutter and includes a passage 88 to which a vacuum can be selectively applied. Within placer probe 88 there is a tacking probe 90, which is heated by an appropriate electric heating element 92

[0075] The sequence of forming and applying a tab is illustrated in Figs. 17A, 17B and 17C. As the press closes, the foil is held across the die cutting members 82 at each of the stations, and the cut edge 85 of the reciprocating cutter 84 passes through cut edge 83, separating a tab from the foil. Placer probe 87 contacts the tab, with the vacuum switched on, and carries the tab into contact with the shell below, covering the pour opening. In the tab embodiment shown the tail of the tab extends over the edge of the shell. Pressure against the adhesive on the lower surface of the tab against the shell is sufficient to initiate tacking the tab in position. The tacking probe 90 descends with placer probe 87 against a small area of the tab and forms a heat seal which will hold the tab in place on the shell for further operations.

[0076] As the press then opens, one of the frames performs a sequence of advancing the foil strip FS by one increment to prepare for the next forming and placing of a tab at each of the stations IT--XII-T and the belts are indexed to bring the next set of nests into alignment with the

tab forming and placing stations. During the next press cycle, the other frame performs the foil advancing sequence. However, one of the frames is always holding the foil whenever an advancing sequence is not being performed.

[0077] Following are charts explaining the timing of the increment feeding movements of the frames.

### Foil Blank, Transfer to Shell

Press Crank °Rotation	Function
0 (TDC)	[Start]
106	Sect. 1 stripper indexed into start position, vacuum on
118	Foil blanked out, transfer punch air on
10 170	Transfer punch extended, vacuum off
180 (BDC)	Foil heated, tacked to shell
190	Transfer punch retracts
242	Blank punch clears bridge, Sect. 2 stripper clamps foil
248	Section 1 stripper releases
15 254	Sect. 2 stripper begins next index and Sect. 1 stripper returns to start position
360/0 (next TDC)	
106	Sect.2 stripper indexed into position
118	Foil blanked out, transfer punch air on
20 170	Transfer punch extended
180	Foil heated, tacked to shell
190	Transfer punch retracts
242	Blank punch clear bridge, Sect. 1 stripper clamps foil
248	Sect. 2 stripper releases
25 254	Sect. 1 stripper begins next index, Sect. 2 stripper returns to start



### **Tab Sealing and Reformation**

[0078] As the shells with tabs 25 attached are advanced they reach sets of tooling I-R--XII-R which reform the pour opening area of the shells and the tabs thereon. The details of this tooling are illustrated in Figs. 23--26. One of the upper tools is shown in Figs. 23, 25 and 26, including a punch 100 with a reforming surface 102 shaped to define a taper about the periphery of the pour opening, extending outward and slightly downward from the pour opening rim. The shape of the pour opening is, in the described embodiment, a triangle with rounded corners, the base of such triangle being adjacent the perimeter of the shell. Adjacent but spaced from the apex of the pour opening reforming surface 102, near the center of the shell, is a bar formation 104 with rounded edges, which acts similarly to a coining tool to concentrate heat onto the forward area 27 of the tab 25 (Fig. 3B) at the edge of the shell opposite the pour opening. The purpose of this is to make an especially firm bond of the tab to the shell which discourages pulling the tab totally from the shell when the tab is opened. The upper tool includes a small electric heater 105.

[0079] The lower reforming tool 110 (Figs. 24,25 and 26) includes an anvil-like surface 112 shaped to conform with upper tool surface 102, to press the combined shell and tab when the tools close and form an upwardly sloping area 113 about the pour opening and stretch the tab in that area as it is firmly heat sealed to the shell. The lower tools also have a bar formation 114, complementary to upper tool bar 104, and a separate electric heater 115, along with a thermocouple 116 to provide a reference for the control for heaters 105 and 115.

[0080] While metal faces for the reforming tool surfaces 102 have been satisfactory, better results have been observed by providing the face portion of the upper tool(s) as a heat conducting hard rubber which has sufficient resilience to smooth the foil of the tab without tearing it as the tools close during a press cycle, thereby providing a uniform bonding of the tabs over and around the pour openings and the surrounding shell surface.

[0081] Figs. 25 and 26 show a cross-section through one station of the reforming tooling, including a nest with a shell between them (the adjoining portions of belt(s) 60 is omitted). Fig. 25 shows the tools open, and Fig. 26 shows them closed. Heat can be applied to the reforming

tools from approximately 661 after TDC for approximately 2881 (or 661 before TDC) of the press cycle.

[0082]        There may optionally be one or more idle station positions along the belts 60A--60D after the reforming stations, to allow time for cooling and setting of the heated tabs sealed to the shells. The finished ends can be removed from the nest with conventional upstacker mechanisms (not shown) or can be carried in nests 65 around the drums 57 into the beginning of the return flights 60LF. In the latter case, a knock-out device, extending into the space between the belt flights 60UF and 60LF, includes brackets 170 attached to press ram R (Figs. 5 and 7). Knock-out rings 172 on the brackets are positioned such that when ram R descends, finished ends are ejected downward from the downward facing nests onto chutes where they are pushed by air streams (e.g. from compressed air pipes) to the end of the chutes.

[0083]        While the methods herein described, and the forms of apparatus for carrying these methods into effect, constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to these precise methods and forms of apparatus, and that changes may be made in either without departing from the scope of the invention.